

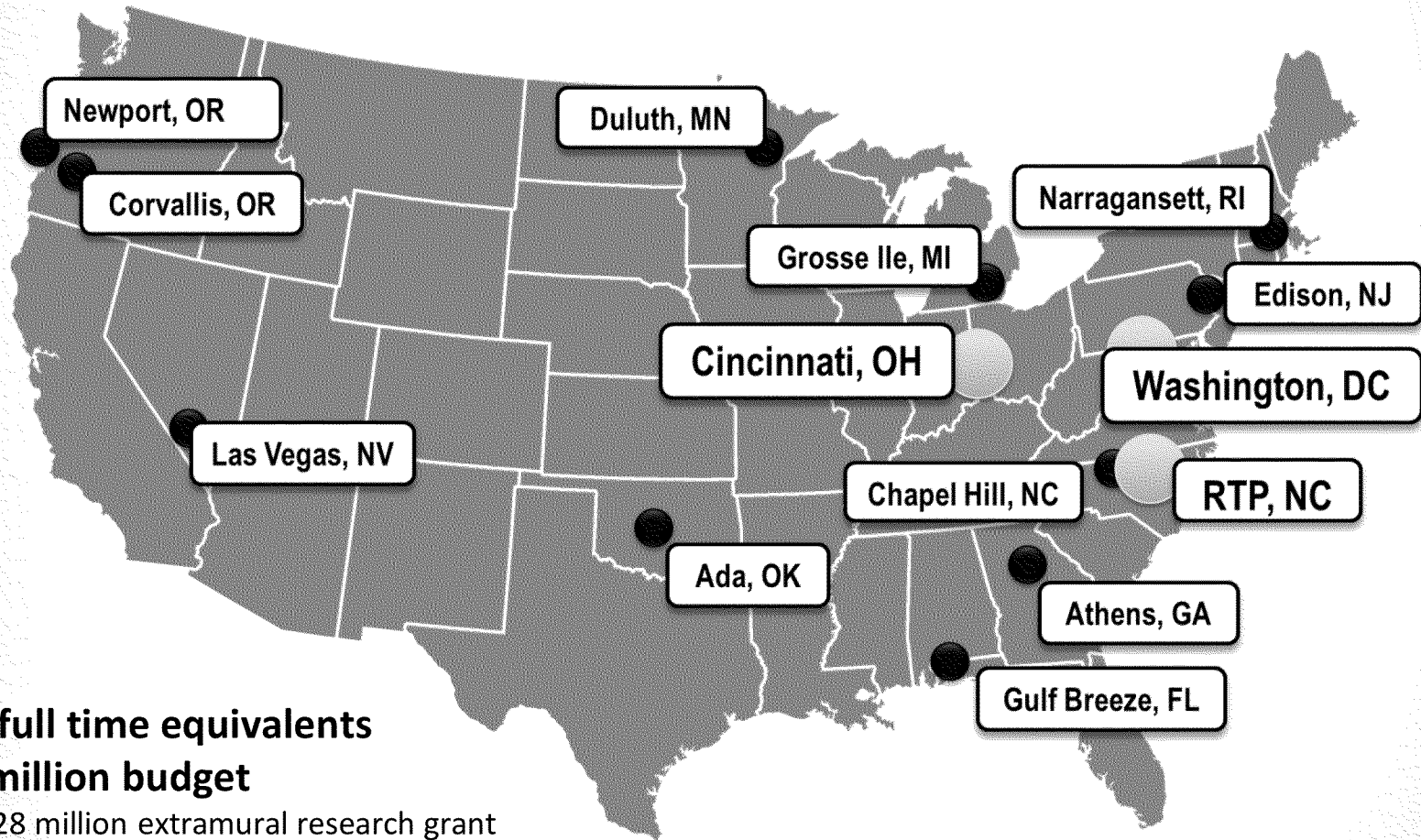


Overview of U.S. EPA's Office of Research and Development

States' Visit to Gulf Ecology Division
September 28, 2017



ORD at a Glance



1,704 full time equivalents

\$498 million budget

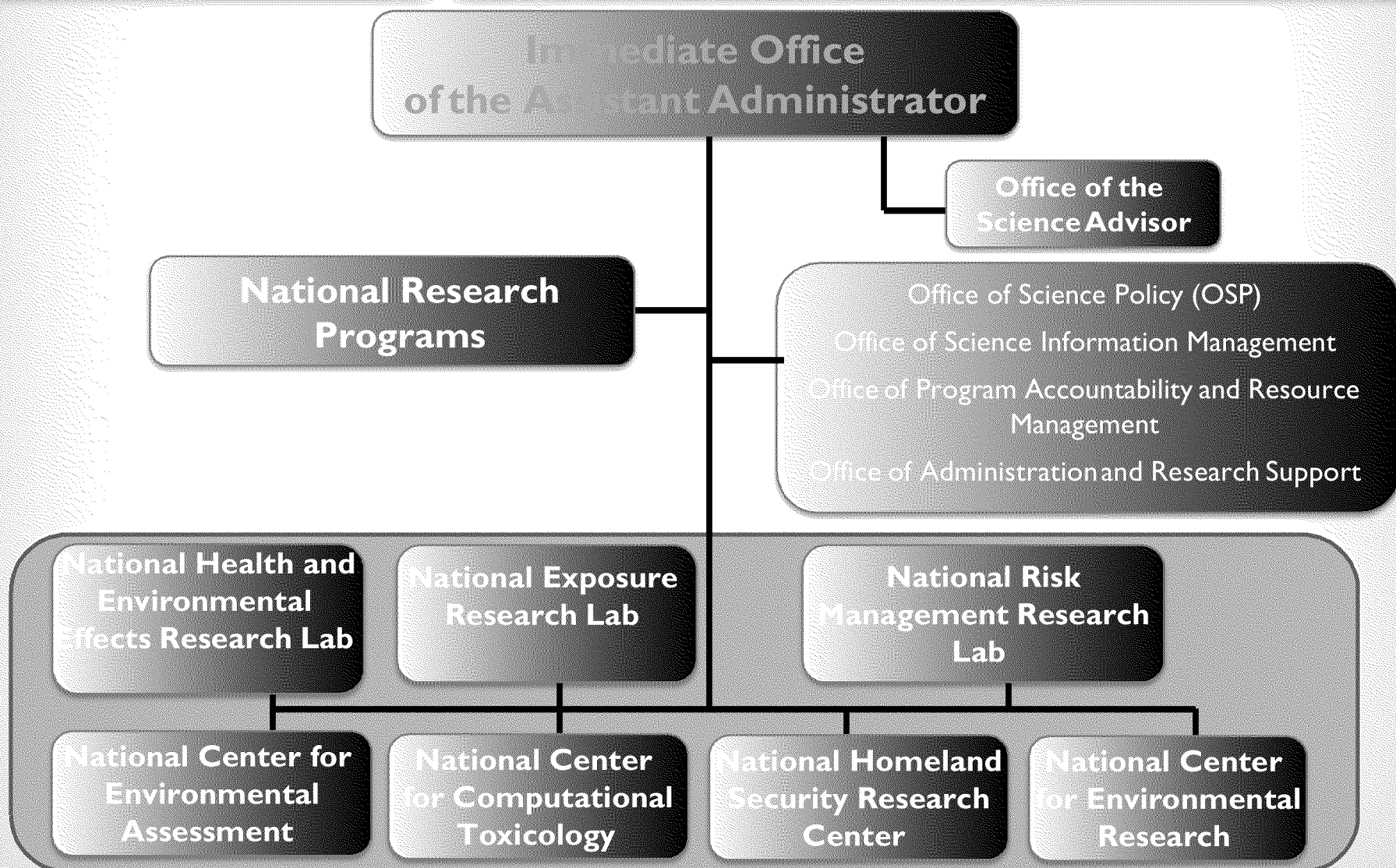
\$28 million extramural research grant
program (STAR)

13 research facilities

(FY 2017 Enacted Budget)



ORD Organizational Chart





Research Authorization

EPA's research provides science that is authorized by nearly 50 environmental laws including:

- **Toxic Substances Control Act (TSCA):** “conduct such research, development, and monitoring as is necessary to carry out the purposes of this Act.”
- **Safe Drinking Water Act (SDWA):** “conduct research, studies, and demonstrations relating to the causes, diagnosis, treatment, control, and prevention of physical and mental diseases and other impairments of man resulting directly or indirectly from contaminants in water, or to the provision of a dependably safe supply of drinking water.”
- **Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA):** “shall assure the initiation of a program of research designed to determine the health effects (and techniques for development of methods to determine such health effects) of such substance... and in combination with other substances with which it is commonly found.”
- **Clean Air Act (CAA):** “shall establish a national research and development program for the prevention and control of air pollution.”



ORD Research

ORD provides the scientific foundation for EPA to execute its mandate to protect human health and the environment.

1. **Longer Term, Anticipatory Research:** ORD conducts innovative and anticipatory research applied to EPA program and regional needs including air, water, land and homeland security to solve longer term environmental challenges, and provide the basis of future environmental protection.
2. **Research on Specific Environmental Challenges:** ORD experts provide research support to EPA program and regional offices, as well as states, tribes and communities, to help them respond to contemporary environmental challenges.
3. **Technical and Emergency Support:** Because of our expertise, local, state and national officials come to us for technical support to respond to environmental crises and needs, large and small.



Research Programs

Air, Climate & Energy

- *Air pollution*
- *Global climate change*

Sustainable & Healthy Communities

- *Ecosystem services*
- *Human health*
- *Sustainable materials management*

Homeland Security

- *Water system security*
- *Resilience and remediating wide areas*

Chemical Safety for Sustainability

- *Computational toxicology and exposure*
- *Evaluation of risk across life cycle of manufactured chemicals, materials and products*

Human Health Risk Assessment

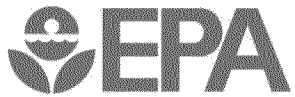
- *Risk assessments for specific chemicals*
- *Risk assessment methods*

Safe & Sustainable Water Resources

- *Drinking water treatment systems*
- *Surface water quality*
- *Green infrastructure*



1. Longer Term, Anticipatory Research

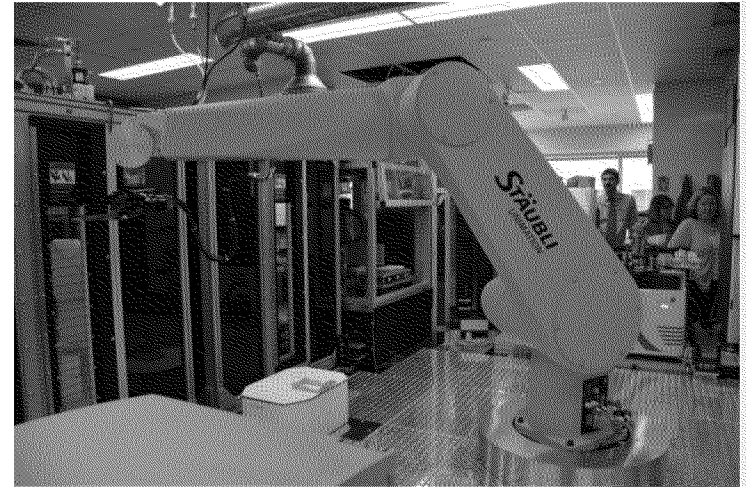


Chemical and Exposure Science

EPA's Computational Toxicology research applies cutting-edge technologies to efficiently and economically evaluate the safety of thousands of chemicals currently in use.

Advances in chemical research include:

- **Rapid testing for chemical exposures** combined with EPA's toxicity data to prioritize chemicals based on their potential to cause health risks
- **Alternatives to animal-testing** that are faster and less expensive, aligning with new TSCA standards
- **Publicly available data and tools** for use by states, companies and the scientific community
- **Tox21 partnership** with the National Institute of Environmental Health Sciences (NIEHS), National Institutes of Health (NIH) and U.S. Food and Drug Administration (FDA)
- **Endorsed by recent NAS Report**, "Incorporating 21st Century Science in Risk-Based Evaluations"
- **Global interest** in applying new methodologies to accelerate the pace of chemical risk assessment





Homeland Security Research

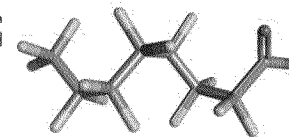
- **ORD's Homeland Security Research Program** focuses on protecting water systems security, and remediating wide-area contamination incidents.
- For more than a decade, ORD has been assessing the best methods to identify and decontaminate threats from chemical, radiological and biological agents.
- **Advances in decontamination research include:**
 - Identifying and testing several anthrax decontamination technologies during the Bio Response Operational Testing and Evaluation project, in partnership with the Department of Homeland Security (DHS).
 - Evaluating decontamination techniques in real-world situations to measure the costs and effectiveness of each method, and the expense of managing waste from cleanup.
 - Determining the best ways to bring transportation systems, like subways, back to service following an event as part of the Underground Restoration Project where we worked with DHS and the Department of Defense (DoD).



2. Research on Specific Environmental Challenges



Perfluoralkylated Substances (PFAS)



- More than 1,000 different PFAS in the TSCA inventory and some are used in everyday products, including stain resistant materials, non-stick cookware and firefighting foam.
- PFAS contamination in soil and water, including Hoosick Falls, NY; Joint Base Elmendorf Richardson in Anchorage, AK; and Wurtsmith Air Force Base in MI.
- Studies indicate that PFAS are associated with low infant birth weights, effects on the immune system, liver effects, increased cholesterol levels, cancer, and thyroid hormone disruption.
- **ORD researchers are:**
 - Studying the potential hazards of PFAS in the environment using cutting-edge technologies pioneered by our computational toxicology research
 - Developing a standardized method for remediation of PFAS in groundwater, ambient water, soil and sediment
 - Developing robust analytical methods for ground, surface and wastewater, as well as for solids including soils, sediments and biosolids

Gulf of Mexico Hypoxia Research

- **Indicators**

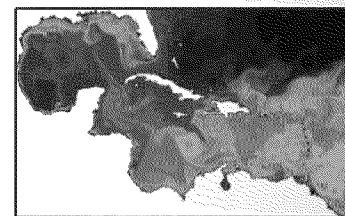
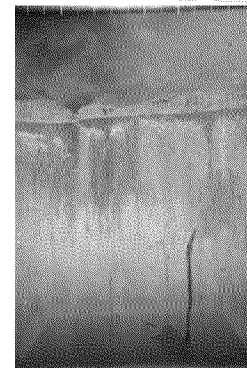
- **Use sediment profile imagery to characterize hypoxia effects** on benthic habitat condition and function.
- **Document responses of the microbial community** to nutrient enrichment and validate microbial community structure as a biological indicator.

- **Effects**

- **Determine responses of estuarine organisms** to combined low acidity and dissolved oxygen.
- **Identify species and life stages that are sensitive** to hypoxia and determine thresholds of adverse effects.

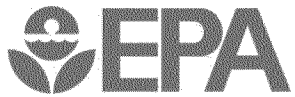
- **Models**

- **Predict responses of coastal ecosystems to nutrient loading** with emphasis on nutrient-enhanced hypoxia and coastal acidification.
- **Forecast effects of nutrient management** actions on hypoxia in the Gulf of Mexico
- **Advance science and application of water quality modeling** including approaches to quantify sources of error and uncertainty in hypoxia forecasts.





3. Technical and Emergency Support



Toledo Drinking Water Crisis

- August 2014, the Mayor of Toledo, Ohio, issued a “Do Not Drink” order for the 500,000 people of the City of Toledo and neighboring communities because the water utility detected cyanobacterial toxins in their treated drinking water stemming from a harmful algae bloom.
- Working with the City of Toledo, Ohio EPA requested emergency technical assistance from EPA ORD with laboratory analyses for the presence of cyanobacterial toxins, and with identifying the optimal approach for controlling those toxins in the plant and distribution system.
- ORD scientists helped with sampling and analysis protocols, recommended approaches for controlling the toxins in the treatment plant and distribution system, and assessing the effectiveness of various treatment processes.
- The critical information provided by ORD helped the Mayor of Toledo and the Governor of Ohio with the decision on when to lift the “Do Not Drink” order.



“Your efforts were instrumental in restoring safe drinking water to over ½ million Ohioans and exemplifies a great example of how local, state and federal agencies are able to work together, mobilize essential resources and address critical issues.”

**—Governor John R. Kasich
(in a letter to USEPA staff
following crisis)**



Other Emergency Response

- **ReAChback for Emergency Response**
 - Quick-response scientific support capability to ensure coordinated, timely response to large-scale disasters
- **Corpus Christi, TX Drinking Water Contamination**
 - Identified decontamination approaches to purge the drinking water systems of the contaminant
- **Flint, MI Drinking Water Crisis**
 - Developed sampling protocols and exposure risk assessment models for lead in drinking water, and distribution system monitoring for disinfectant and disinfection byproducts
- **Ebola Response**
 - Prepared for Ebola patients in U.S. by identifying decontamination methods for Personal Protective Equipment for health care workers, technical support for waste management, and the fate of the virus in wastewater
- **Gold King Mine**
 - Provided toxicity information and developed modeling for long-term monitoring
- **Elevating Critical Public Health Issues Policy**
 - Developed a process to allow staff to expedite the elevation of important issues



State Engagement *Recent Accomplishments*

- **State Research Needs**

- Through a series of state meetings and ECOS/Environmental Research Institute of the States (ERIS) surveys, ORD better understands the science needs of state environmental agencies. This information helps ORD ensure our research is useful and practical for states to help address their on the ground problems.

- ***ECOS and ORD: Partners for Meeting State Research Needs, September 2017***

- This most recent summary compiles stories of how ORD's work during the past 5 years has supported states in their efforts to protect human health and the environment.

- **Memorandum of Agreement with ECOS and the Association of State and Territorial Health Officials (ASTHO), April 2016**

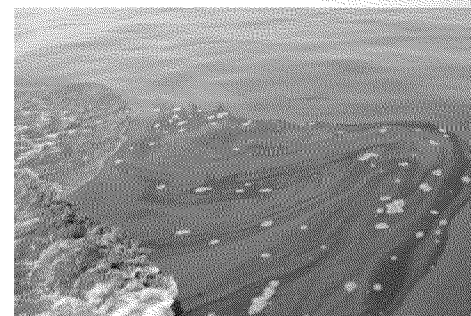
- Two ORD pilots with state partners on the *Wildfire Smoke Guide for Public Health Officials* and EPA's Community-Focused Exposure and Risk Screening Tool (C-FERST). New project on communicating the risks of PFAS and HABs.

- **Webinars on Research Products and Tools**

- *EPA Tools & Resources* monthly series addresses state identified priority areas and provides a mechanism for state input on ORD research (initiated January 2016).

- **Outreach and Collaboration**

- Over the past 6 years, hosted visits for ECOS members and other state officials to ORD labs to share our scientific capabilities and discuss research topics of interest to states.



"When we were faced with an emergency in Toledo due to cyanobacterial toxins detected in their treated drinking water, ORD staff was a great partner and exceeded our expectations in understanding science and helping optimize treatment and restore safe drinking water to our residents."

—Ohio EPA Director
Craig Butler



State Research Priorities

Water Quality

- Nutrients
- Stormwater
- Water reuse
- Wastewater infrastructure
- Small system drinking water and wastewater treatment

Emerging Contaminants/Toxics

- Manage new chemicals of emerging concern and existing chemicals (e.g. PFAS)

Waste/Remediation

- Soil
- Groundwater
- Surface water
- Sediment

Air

- New ozone standard
- Interstate and cross-border transport



2016 ERIS States' Research Needs Survey Summary:

<https://www.ecos.org/wp-content/uploads/2017/04/ERIS-Survey-Summary-One-Pager.pdf>



ORD Support for States *Some Recent Examples*

10

AK – PFAS
ID – Modeling for agriculture, energy, water and air systems interactions
OR – Water nitrate contamination; Tools to help communities identify environmental issues; Ocean acidification research; Reducing methyl mercury levels; Advanced monitoring technologies
WA – Managing nutrients in riparian ecosystems; Habitat suitability models

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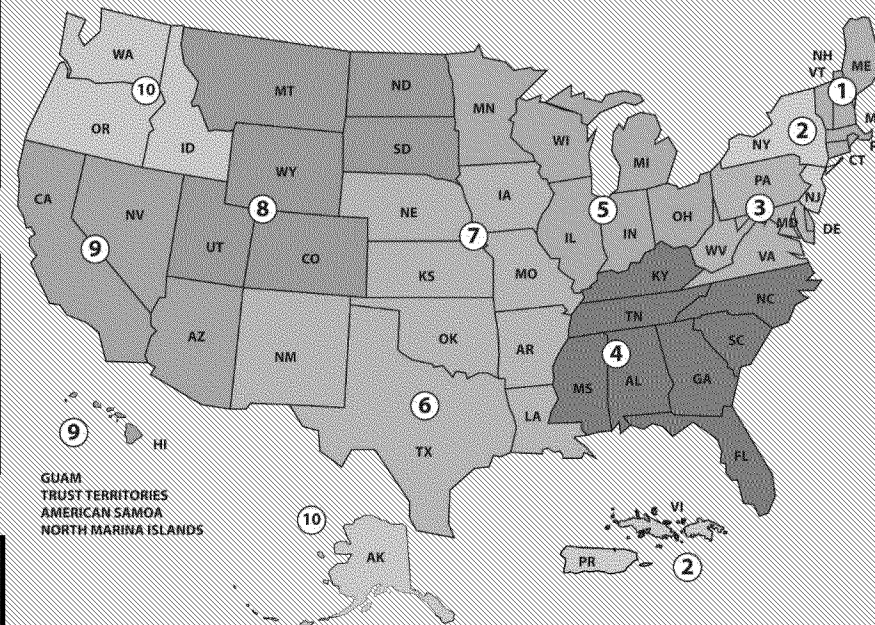
CA – Evaluating chemicals; Population and land use projections; Synthetic turf field safety; Decontaminating subway railcars; Decision support tools to advance communities' priority projects; Risk assessment training; Advanced monitoring technologies
NV – Groundwater characterization and remediation

8

CO – Simulating conditions in drinking water utilities; Advanced monitoring technologies
MT – IRIS assessment for Libby Amphibole Asbestos; Asbestos exposure following forest fires
UT – Fine particle air pollution; Emissions measurement methods

7

IA – High ammonia levels in drinking water
KS – Prairie rangeland burning; Community air quality monitoring
MO – Models and tools to reduce sewer overflows



6

LA – Cancer risk assessments
OK and TX – Community air quality monitoring
OK – Chemical composition analysis; Evaluating water interactions at Superfund site
TX – Chemical contamination risks

5

MI – Lead contamination technical support; Simulating conditions in drinking water utilities
MN – Sulfate standard development support; Modeling bioaccumulation of PCBs and mercury in fish
OH – Harmful algal blooms limiting drinking water; Managing algal toxins; Small drinking water systems; Simulating conditions in drinking water utilities
WI – Predicting water quality at beaches

1

CT – Community air quality monitoring;
CT, MA, ME, NH, RI and VT – Stream monitoring network; Planning for energy and air emissions
CT and NH – Advanced monitoring technologies
ME – Tribal risk assessment (sediment and water quality)
VT – Impervious cover data for watersheds

2

NJ and NY – Stream monitoring network; Planning for energy and air emissions
NJ – PFAS
NY – Management of bio-hazardous wastes; Planning for biological incident; Simulating conditions in drinking water utilities

3

DE, MD, PA, VA and WV – Stream monitoring network
MD – Managing stormwater treatment systems; Advanced monitoring technologies; Reducing harmful air pollutants; Management of bio-hazardous wastes
MD, PA and VA – Stormwater management planning support
PA – CADDIS causal assessment; Community air quality monitoring

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AL, GA, KY, NC, SC, TN – Stream monitoring network
FL, GA, KY, NC, SC, TN – Characterizing urban background levels for contaminated site cleanup levels
FL, KY – Simulating conditions in drinking water utilities
GA – Green infrastructure in Atlanta's Proctor Creek
KY – Advanced monitoring technologies
MS – Fecal bacterial and viral indicators
NC – Community air quality monitoring; STEM education; Wright Chemical Superfund Site
SC – Food waste reduction



For More Information

- **EPA Research web page**
www.epa.gov/research
 - **States and ORD: Partners to Meet State Research Needs**
<https://www.epa.gov/research/states-and-ord-partners-meet-state-research-needs>
 - **EPA Tools and Resources webinar series**
<https://www.epa.gov/research/epa-tools-and-resources-webinar-series>
 - **EPA Strategic Research Action Plans**
<http://www.epa.gov/research/strategic-research-action-plans>
 - **EPA Methods, Models, Tools and Databases**
<https://www.epa.gov/research/methods-models-tools-and-databases>
- **EPA Science Matters newsletter**
<https://www.epa.gov/sciencematters>
- **It All Starts with Science blog**
<http://blog.epa.gov/science/>
- **Join more than 21,000 followers on Twitter**
<https://twitter.com/EPAresearch>



APPENDIX

- **Sensor Technology Research and Challenges**
 - Creating challenges, prizes and other incentive-based strategies to find innovative, cost-effective solutions to environmental challenges, such as monitoring pollution
- **National Aquatic Resource Surveys**
 - Supporting assessments of the Nation's waterways and wetlands to compare their condition over time and to support states in managing their aquatic resources
- **Oil Spills Research**
 - Mitigating the effects of past and future oils spills by developing laboratory protocols for the National Contingency Plan Product Schedule, providing guidance on bioremediation following spills and demonstrating important factors for dispersion of oil into the water column
- **Enabling Local Decisions**
 - Developing tools and approaches to effectively translate science and communicate public health information to people affected by environmental issues, such as wildfires
 - Developing tools to help communities understand how a decision, such as building new roads, will impact their local communities and environments
 - Conducting research to understand how ecosystems services, such as clean air and water, fertile soil, and flood control, interrelate with human health and well-being

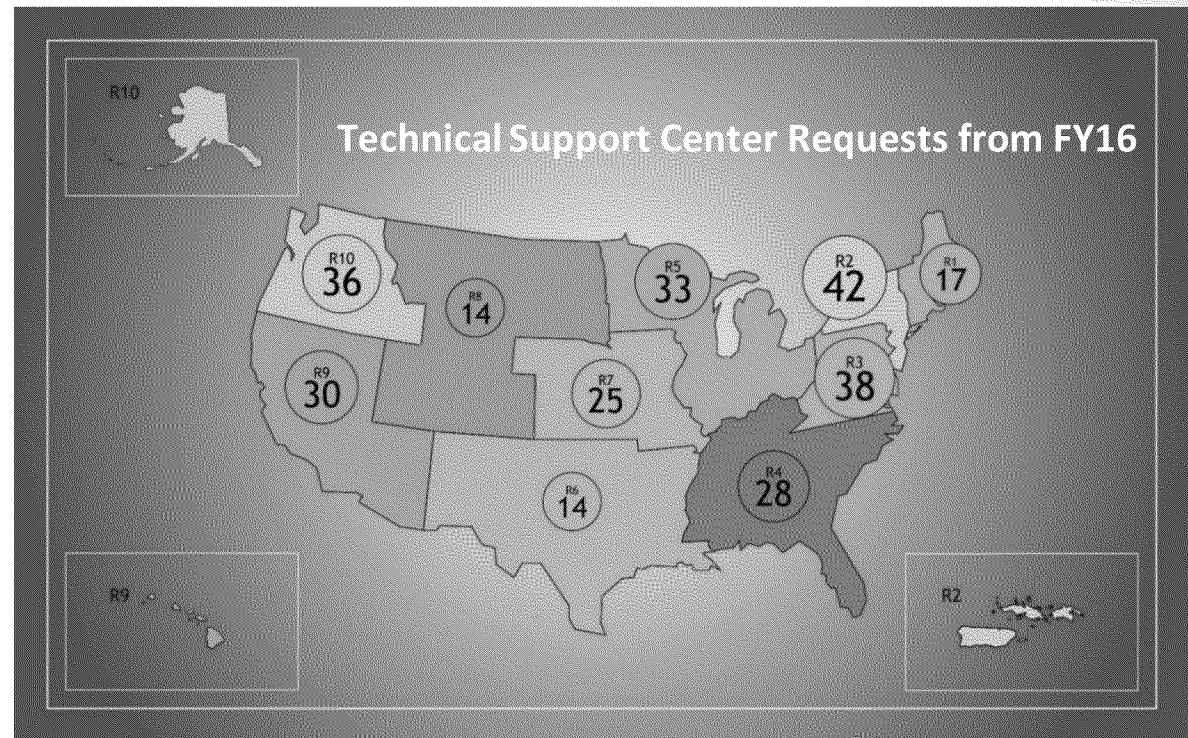


Other Contemporary Activities

- **Chemical Evaluation**
 - **TSCA Implementation**
 - Providing research expertise to evaluate specific chemicals and framing broader assessment activities within timelines mandated by the new law
 - **Integrated Risk Information System** to enable 21st century chemical evaluations
 - **Integrated Science Assessments**
 - Creating evaluations and syntheses of the most policy-relevant science for reviewing the National Ambient Air Quality Standards
 - **Environmental Contaminants**, such as Lead Exposure, Methyl Bromide
- **Recycled Tire Crumb Used on Playing Fields and Playgrounds**
- **Harmful Algal Blooms**, monitoring algal blooms and building an early warning indicator system for toxic and nuisance blooms
- **Small Water Systems Research**
 - Information, tools, training workshops and webinars, and technical assistance to state, local and utilities personnel so that they can reduce costs and deliver safe, clean drinking water

Technical Support Centers

- ORD has **Technical Support Centers** that respond to requests from EPA's program offices and regions at Superfund, Resource Conservation & Recovery Act (RCRA), and Brownfields sites.
- 15 million pounds of explosive propellant were found at the **Camp Minden site in Doyline, LA**, after a portion of the stock detonated in 2012. ORD helped Region 6 (South Central) and DoD by recommending a low-emission controlled burn system for rapid material disposal. Since its activation in 2016, the system has destroyed over 4 million pounds of propellant.

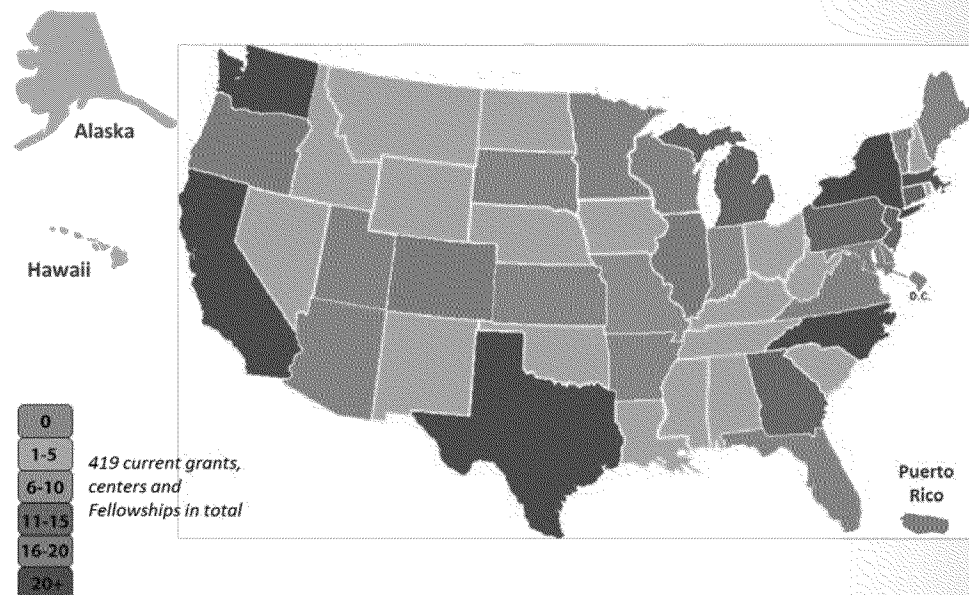




Extramural Research

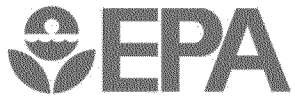
Science to Achieve Results (STAR)

- EPA's STAR program funds research grants through a competitive selection process.
- STAR engages some of the nation's best scientists and engineers in research that complements EPA's own research.
- Map shows extramural research grants, centers, and Fellowships active in FY15.



Small Business Innovation Research (SBIR) Program

- Mandated by the Small Business Innovation Development Act of 1982, EPA's SBIR program provides critical early-stage capital for innovative small companies in the green tech arena.
- Since 1982, SBIR has supported 616 individual small businesses with 1,782 (1329 Phase Is, 453 Phase IIs) awards and around \$186,000,000 in 46 states (as of 2016).
- A great SBIR success is the company Ecovative, which developed an innovative technique using mushrooms to create water-resistant, flame-retardant, compostable, heat-trapping insulation that is as strong as concrete by weight.



ORD's Regional Science Program

The Regional Science Program links ORD to EPA's regional offices, and promotes integrating ORD science into regional and state decision, coordinates programs involving regionally-focused research with state or local partners, and provides technical support to regions, states and communities.

- Key components include:
 - **Regional Applied Research Effort** – Responds to high priority, near-term applied research needs of EPA's regions, state and local governments, and tribes
 - **Regional Research Partnership Program** – A short-term training program that provides opportunities for regional scientists to work with ORD researchers
 - **Regional-ORD Community of Science Networking Program** – A networking program for regional scientists and engineers who have limited familiarity with ORD



Assessing Cancer Risks

Partner: Louisiana Department of Environmental Quality (LDEQ);
LaPlace, LA

Challenge: Potential cancer risks from emissions of chloroprene
(completed)

Resource: IRIS assessment and air quality monitoring

- ORD scientists assisted Region 6 (South Central) and Louisiana with their evaluation of potential cancer risks of chloroprene emissions from the Denka Performance Elastomer facility in LaPlace.
- Ambient air monitoring near the facility showed high levels of chloroprene in the area. EPA researchers characterized potential health risks associated with chloroprene.
- EPA directly supported Louisiana in achieving action to reduce public health risks from the chloroprene emissions.



I want to thank EPA ORD for their assistance in gathering and interpreting air quality data from around the Denka Performance Elastomer facility in LaPlace, LA. The information ORD provided helped the LDEQ design and implement actions to reduce chloroprene emissions from the plant. The multi-step Denka remedy is in the first stages of its implementation and has already produced significant reductions in chloroprene emissions.

When agencies work together, everyone benefits."

—LDEQ Secretary
Dr. Chuck Carr Brown

Developing Restoration Alternatives

Partners: Florida Department of Environmental Protection (DEP), South Florida Water Management District (SFWMD)

Challenge: Saltwater encroachment damaging freshwater vegetation communities in the floodplain (ongoing)

Resource: Time series salinity model as a tool for development and evaluation of restoration alternatives

- In 1985, the Loxahatchee River became a federally-designated National Wild and Scenic River, but anthropogenic alterations of its watershed resulted in encroachment of a saltwater-tolerant, mangrove-dominated community into the freshwater floodplain.
- EPA ORD scientists developed a salinity modeling tool in a user-friendly Excel© platform, to screen for restoration alternatives that help restore the Loxahatchee River ecosystem. The tool's spatial features estimate salinities, and simulated salinity data are used to quantify ecological benefits with respect to habit lifts of vegetation, fish larvae, oysters and seagrasses.
- Stakeholders from the SFWMD and Florida DEP are using this tool in developing restoration alternatives, while EPA ORD scientists continue to provide technical support for model development and application.



"The salinity tool will allow the ecological sub-team... to evaluate the various potential project features to determine what grouping of features... performs the best for the restoration of flows to the federally designated Northwest Fork. The tool allows us to take the differing flow scenarios from the watershed and predict how those flows will change the salinity regimes in the river and therefore affect the location, health and survival of key indicator species such as juvenile fish, submerged aquatic vegetation and oysters."

– SFWMD Applied Science Bureau,
Coastal Ecosystems Section Science
Supervisor Patti Gorman



Nitrogen Pollution in Urban Environments

Partner: Florida Department of Environmental Protection (DEP), Escambia County

Challenge: Nitrogen pollution in urban environments (ongoing)

Resource: Isotopes as tracers to identify sources of nitrogen pollution

- Bayou Chico is part of Florida DEP's basin management action plan to improve water quality through reductions in nitrogen loadings. Jackson Creek and Jones Creek in the watershed provide urban settings to compare nitrogen loadings between contrasting land use and land coverages.
- EPA ORD scientists, Region 4 (Southeast) and partners are collecting water and sediment samples in the creeks and watershed to compare potential sources, fate and transport of nitrogen. Samples are analyzed for a suite of water quality chemical parameters (nitrite, nitrate and chemical tracers of wastewater discharge).
- This project is providing the technical basis for the County and Florida DEP to better understand nutrient loads and sources in the watershed informing decisions for the basin wide management action plan.



"Our partnership with EPA ORD offers us a wonderful opportunity to gain a better understanding of nutrient loads and likely sources within the Bayou Chico and Pensacola Bay watersheds. Funding for environmental restoration is always limited. Having this understanding allows Escambia County and our partners to prioritize projects that have the greatest potential to have a positive impact on our ability to attain our surface water quality goals. We hope to use this research in the future as the basis for better resource management decisions."

– Escambia County, Water Quality & Land Management Division Manager
Brent Wipf